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Geology of the Murrindal River—Yalmy River Area East of Buchan, Victoria

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Abstract

The area E. of Buchan has extensive exposures of Snowy River Volcanics with a total thickness of about 8,000 feet, consisting of rhyodacites, pyroclastics and tuffs, with subordinate andesites, rhyolites and minor non-marine sediments. The eastern edge of the volcanics is downfaulted against tightly folded Ordovician sandstones, siltstones and cherts. The volcanics dip to the west and are overlain unconformably by fossiliferous Buchan Caves Limestone along the Murrindal R. Deposition of the limestone followed block faulting and planation of the volcanics. A block of Ordovician sediments and pre-Devonian granodiorite lies within the volcanics and represents the northern portion of a narrow belt of strong faulting extending from Nowa Nowa. Post Middle Devonian down-faulting preserved remnants of Buchan Caves Limestone of which there are five discrete enclaves within the volcanics.

Introduction and Previous Literature

An area of about 50 square miles is dealt with in this paper with a relief ranging from 300 to 2200 ft above sea level. Much of it is thickly vegetated. Portions of the area, particularly the limestone enclaves, have been studied by previous workers. The first of these was A. W. Howitt (1876) who reported briefly on the limestone of the Basin Ck and Yalmy R., the sediments at Mt McLeod, and described some of the volcanics of the area. In a later report Howitt (1882) described the basalts underlying the limestone near the confluence of the Buchan R. with the Snowy R. The age of the limestone enclaves was determined as Buchan Caves Limestones equivalent by Teichert and Talent (1958). While comparing the plutonic rocks of the Nowa Nowa area with other adjacent plutonic bodies Cochrane and Sampson (1947) found the Whisky Ck granitoid body to be a hornblende-rich acid plutonic. The area has been mapped in a general way by Gaskin (pers. comm.) in about 1950 but the sketch map produced has since been mislaid. Thus the relationships between the volcanics, limestone and the pre-Devonian rocks were still largely unknown and detailed work within the volcanics was lacking.

Ordovician

Low-grade dynamically metamorphosed sediments of Upper Ordovician age constitute the oldest rocks in the area. These outcrop extensively in the eastern portion of the area and consist of interbedded sandstones, siltstone, and cherts commonly intersected by quartz veinlets and occasionally by thick quartz veins. Lithologically similar rocks occur on Mt McLeod and in narrow belts within the granodiorite of the Whisky Ck area. Strong folding is in evidence with dips ranging to near vertical. The granodiorite is intrusive into the sediments with strong development of hornfels along the contacts. The usual contact between the Ordovician and Snowy River Volcanics is a faulted one but the existence of isolated outcrops of volcanics within the granodiorite area suggests that these are early flows uncon-

formable to the granodiorite and hence the Ordovician. For the most part the rocks are unfossiliferous but similar strata revealed in road cuttings along New Guinea track a few miles to the north of Mt McLeod yielded poorly preserved Upper Ordovician graptolites.

Pre-Devonian

Granodiorite

Granodiorite outcrops over a topographically low area drained by the head waters of the Basin Ck and is almost completely surrounded by steep slopes and cliffs formed by the more resistant volcanics and Ordovician sediments. The granodiorite forms low spurs and ridges; the only feature to rise above the general level is a prominent rounded hill composed of volcanics. World Hill can be interpreted as being a remnant of one of the early flows of the Snowy River Volcanics that was extruded upon the pre-Devonian granodiorite surface; however it is also possible that this and similar outcrops of volcanics within the granodiorite owe their position to faulting. The granodiorite intrudes the Mt McLeod Ordovician sediments to the S. and appears to be bounded elsewhere by large faults. Megascopically the rock is black and white mottled, medium grained, and usually has an allotriomorphic fabric although hypidiomorphic fabrics are occasionally noted. Microscopically the essential minerals are oligoclase-andesine, potash felspar, quartz, hornblende and biotite. Twinned hornblende is the common ferromagnesian mineral in all samples, and forms up to 25% of Sample 170 while biotite is the next most common and sometimes makes up to 15% of the rock. There is probably an increase in hornblende and biotite nearer the contact with Ordovician sediments. Sample 72 is a fairly fresh rock with quartz showing undulose extinction and abundant hornblende accompanied by a few zircons in the form of short prismatic crystals with blunt pyramidal terminations. Green chlorite is also present in small amounts together with magnetite or biotite, and felspars are generally altered to some degree, often severely so, and show zoning around corroded cores. Sample 159 from the east side of Mt McLeod near the contact with the sediments has very altered and corroded silicic plagioclase which is severely sericitized and stained with hematite. Magnetite is abundant, together with shreds of biotite and cracked quartz grains. Abundant penninite occurs in Sample 71 showing an anomalous mauve to blue interference colour and is associated with fine magnetite. In some cases the rock would best be described as a quartz monzonite, as the percentage of silicic felspar of the total felspar in the rock is sometimes more than 50%. Sample 105 is probably such a rock.

Thin veins of pink felspar and quartz, often accompanied by white mica and rarely showing traces of molybdenite mineralization, are common throughout the granodiorite. The age of the granodiorite cannot be accurately fixed, apart from noting that it is post-Upper Ordovician and pre-Lower Devonian.

Lower Devonian

The Snowy River Volcanics include flows, tuffs and pyroclastic rocks of acid composition together with minor non-marine sediments. Within the area under study they are complexly faulted to such an extent that the normal sequence is obscure and their true thickness cannot be determined. Most of the individual rock units often appear to be only of limited extent and rapid changes in lithology are common. Considering the lack of adequate exposures and the restricted area under study no attempt to divide the Snowy River Volcanics into smaller units has been attempted in this paper. Generally the volcanic rocks outcropping E. of Buchan

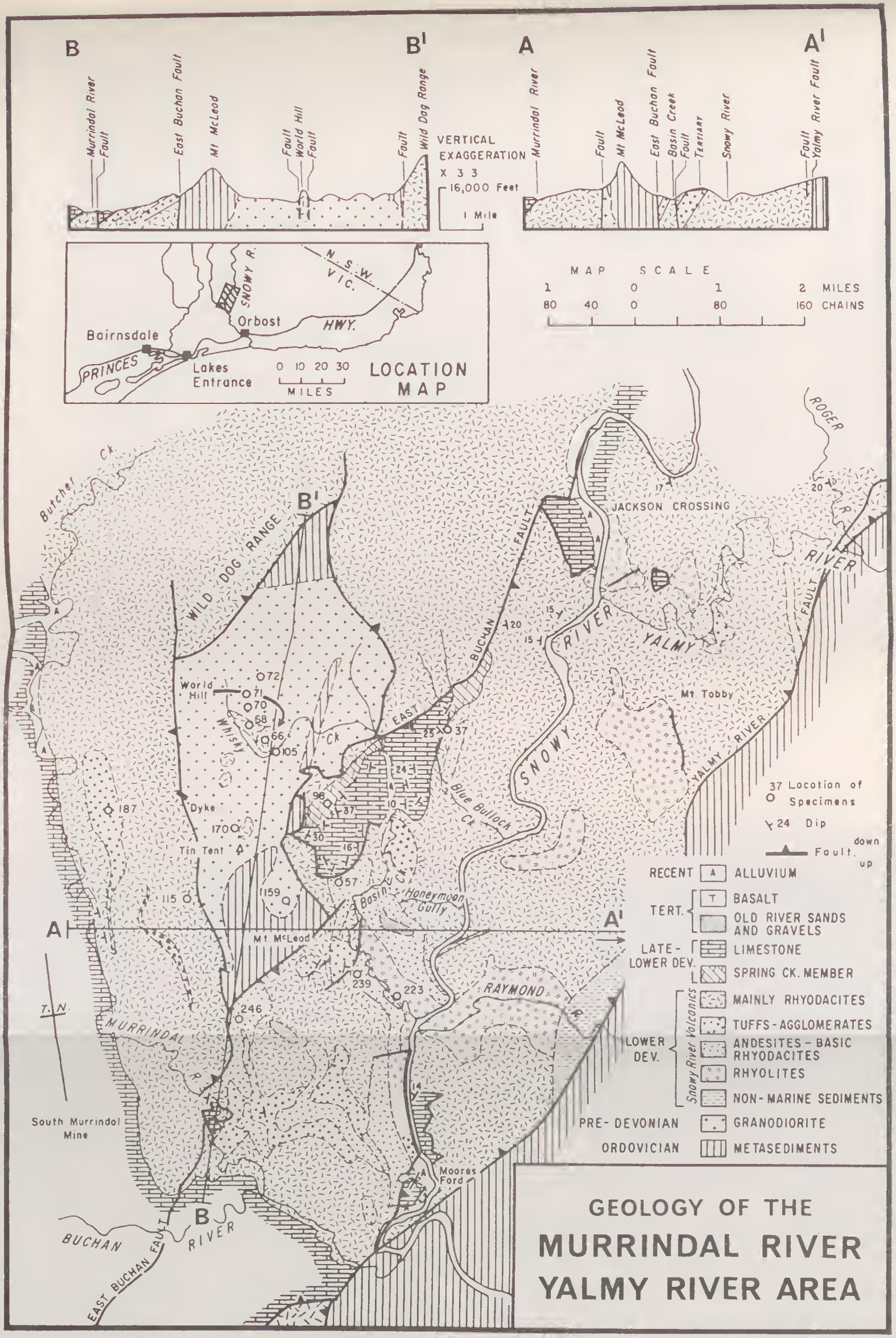
B
B'
A
A'
Murrindal River
Fault
East Buchan Fault
Mt McLeod
Fault
World Hill
Fault
Fault
Wild Dog Range
VERTICAL EXAGGERATION
X 3 3
16,000 Feet
1 Mile
Murrindal River
Fault
Mt McLeod
East Buchan Fault
Basin Creek
Fault
Tertiary
Snowy River
Fault
Yalmy River Fault
SNOWY R.
N.S.W.
VIC.
Orbost
HWY.
Bairnsdale
PRINCES
Lakes Entrance
0 10 20 30
MILES
LOCATION MAP
MAP SCALE
1 0 1 2 MILES
80 40 0 80 160 CHAINS
ROGER R.
Butcher Ck
WILD DOG RANGE
JACKSON CROSSING
BUCHAN FAULT
YALMY RIVER
FAULT
RIVER
World Hill
Dyke
Tin Tent
Basin Ck
Honeymoon Gully
Blue Bullock Ck
EAST SNOWY
Mt. Tobby
YALMY RIVER
Mt. McLeod
RAYMOND R.
MURRINDAL R.
T.N.
South Murrindol Mine
Moores Ford
BUCHAN
EAST BUCHAN FAULT
RIVER
37 Location of Specimens
24 Dip
Fault. down up
RECENT A ALLUVIUM
TERT. T BASALT
OLD RIVER SANDS AND GRAVELS
LATE-LOWER DEV. LIMESTONE
SPRING CK. MEMBER
LOWER DEV. Snowy River Volcanics
MAINLY RHYODACITES
TUFFS-AGGLOMERATES
ANDESITES-BASIC RHYODACITES
RHYOLITES
NON-MARINE SEDIMENTS
PRE-DEVONIAN GRANODIORITE
ORDOVICIAN METASEDIMENTS
GEOLOGY OF THE
MURRINDAL RIVER
YALMY RIVER AREA

FIG. 1

appear to be representative of the upper part of the Lower Devonian succession and indicate that the lower portion (including the Timbarra Formation) has been faulted out by movement along the Yalmy River Fault to the E. of the Snowy R. Because of the variation within even one lithologic type it is proposed to discuss these rocks under a general rock type name, regardless of relative age.

Rhyodacite

The most common lava type in the area is best described as rhyodacite. These flows generally form thick, massive, and very weather-resistant outcrops, as for example those outcropping in the Wild Dog Range, though occasionally they are only a few tens of feet thick and of only local extent as in the beds outcropping along Spooner Ck. In the hand specimen the colour of these rocks varies from dark grey through purple-brown to light salmon pink, the lighter colours being the most common. The rhyodacites are usually medium to coarsely porphyritic with a fine-grained to dense, mostly glassy ground-mass. Sample 115 from the section exposed in Shaw Ck illustrates the coarse nature of many of the rhyodacites, since it contains abundant quartz up to 0·4 cm in size which is corroded and cracked in part, together with acid plagioclase, pinkish and commonly zoned, in a glassy dark purple groundmass. Fine magnetite occurs scattered throughout the rock. Quartz phenocrysts are sometimes almost absent as in sample 66 which is a hard dense dark greenish-grey rock forming a prominent rounded outcrop known as 'World Hill'. It is possible that this is a remnant of an early flow lying on the eroded surface of granodiorite. The main constituents are fine to medium grained phenocrysts of twinned and corroded subhedral plagioclase, sericitized and rimmed with relatively unaltered albite, while smaller quartz and sanidine crystals, euhedral to subhedral, are less common and are frequently corroded by the groundmass. The groundmass is silicified and contains fine felspar and sericite grains. Mica flakes in perfect hexagons up to 0·1 cm diameter are common in this rock and are accompanied by rock fragments consisting of rhyodacite with a few sedimentary rock chips in a purplish-brown groundmass. Mica rhyodacites can usually be found in most parts of the succession and particularly in the rocks exposed in Shaw Ck where there are several flows of this type. Flow structures are sometimes discernible in thin sections but are more commonly absent.

Rhyolite

Lavas referred to here as rhyolites outcrop extensively in the E. and SE. portion of the area where they typically form high cliffs along the banks of the Snowy R. and its tributaries. The rhyolite flow outcropping along the east bank of the lower Basin Ck is about 85 ft thick and the flows to the E. of the Snowy R. are probably much thicker than this and are in the order of a few hundred feet thick. Flow structure is usually very well developed and is typically shown in Sample 223 from an outcrop near the junction of the Basin Ck with the Snowy R. where the cutaxitic nature of the rock is shown by the alternating thin bands of differing colours varying from light brown through purple to dark grey. Weathering reduces the bulk of these bands to a soft, pale brown material with grey resistant bands, thus enhancing the flow structure, and occasional spherulites can usually be seen alternating with bands containing scattered aggregates of fine quartz, felspar, and hematite. Occasionally quartz phenocrysts are present, as in Sample 227, which are mainly anhedral and make up about 30% of the rock. Common opal is often found as fillings in fractures within these rocks.

Andesite

Most of the flows mapped as 'andesite' would be better described as having andesitic tendencies; some are true dacites but due to their distinctive appearance they have been grouped under this term for convenience. Andesitic rocks are almost entirely restricted to the E. of the Murrindal South mine, S. of Mt McLeod and W. of the Snowy R., and it is probable that these rocks are in a zone near the top of the Snowy River Volcanics sequence. Howitt (1882) described rocks underlying the limestone at Moore's Ford on the Snowy R. in the Murrindal South Mine area and along the lower Buchan and Back Ck as 'diabase porphyritic'. There is a belt of andesitic flows commencing at the junction of the Basin and Basin Ridge Roads and continuing S. towards the Murrindal South Mine along the ridge above the road. The andesite overlies a tuffaceous and agglomeratic sequence. Similar rocks occur S. of the Basin Ck bridge and continue down the W. bank of the creek towards the Snowy R. with rhyolite outcropping on the E. side. At the Snowy R. the same relationship exists along the W. bank for at least ½ mile. Between the Basin Road and the southern edge of the Basin limestone, andesitic rocks predominate and may extend farther across the road and around the head of Honeymoon Gully towards the Snowy R. The degree of weathering in these rocks is usually most severe and rarely is fresh rock exposed. Quartz is often present in appreciable amount as in Sample 55, which has abundant zoned and twinned plagioclase laths, magnetite, and small green hornblende crystals in a felted groundmass of felspar laths. In the hand specimen these rocks are often fine grained, dark rocks, but porphyritic varieties are common and phenocrysts of hornblende, plagioclase, or pyroxene are often noted. Hornblende occurs as phenocrysts in Sample 246 from outcrops along the Basin Road near the junction with the Basin Ridge Road. Plagioclase is the dominant phenocryst in Sample 221 of an outcrop at the head of Honeymoon Gully, lying in a groundmass of squat felspars and iron oxide masses. Sample 239 has pyroxene phenocrysts, largely altered, in a groundmass composed of small quartz crystals and plagioclase laths. Green chloritic material is associated with magnetite in much of this groundmass.

Tuffs

Pyroclastic rocks of acid composition make up an appreciable amount of the Snowy River Volcanics. They can rarely be traced any distance in the field since they often closely resemble flows, due to their high susceptibility to alteration. Tuff beds were occasionally used in determining structure and to indicate the strike of some restricted areas of volcanics, particularly in the western portion of the area. The beds frequently show severe silicification, making the distinction between them and flows very difficult, especially when they are not more massive. It is probable that many of the rocks referred to as rhyodacites were originally tuffs but have now undergone such alteration as to make their origin uncertain; however, undoubted tuff beds are known in many parts of the area and contain tuff balls in a few localities. Sample 187 from an outcrop of light creamish indurated tuff north of Shaw Ck contains occasional tuff balls ½ to 1 cm in diameter, and the brecciated silicified tuff near the Basin Ck bridge has flattened tuff balls in some abundance. They have also been noted in the section exposed along Running Ck where tuff and ash beds alternate with rhyodacite flows. The colour of the tuffs varies from green through pale green and light browns to grey; they are usually fine to medium grained and friable to indurated. In the section exposed along a track about 1½ miles N. of Shaw Ck a tuffaceous sequence of nearly 200 ft thickness contains green and cream tuff beds with some tuffaceous sandstone intercala-

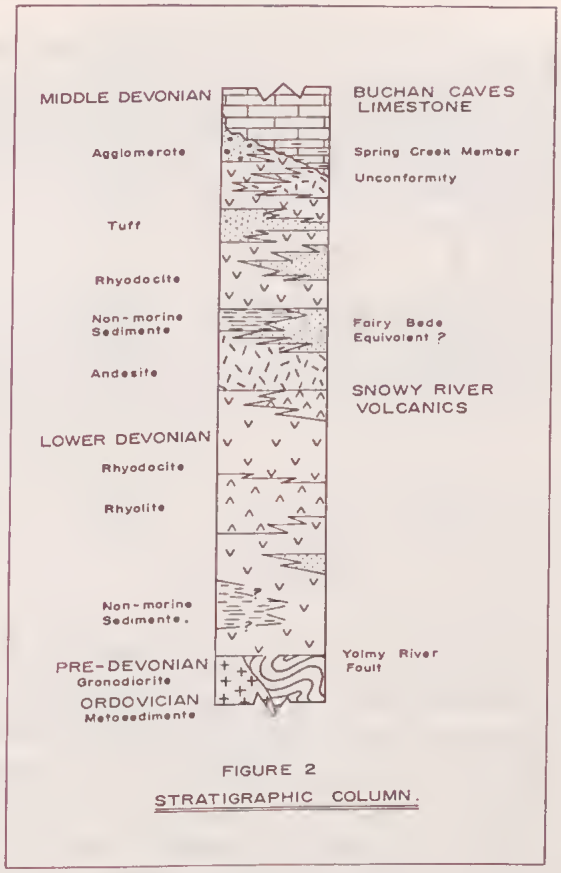

FIG. 2

tions. A few tuff balls have been noted in these beds and the sandstone probably indicates some water sorting. This is evident also in other sections, as in the tuffaceous beds immediately underlying the limestone in the Basin Ck area. In the Basin Ck sections the tuffs are generally silicified but clearly show evidence of reworking as in Sample 37. Exposures in the Blue Bullock Ck from which Sample 37 was taken show fine banding and complex current bedding and consist dominantly of chert which is present in fine bands and as lens-like masses in ash beds. Siliceous solutions derived from the volcanics are probably responsible for the cherty nature of the beds. Coarser grained varieties sometimes occur as in the section exposed in Spooner Ck illustrated by Sample 98 from this locality. This has coarse fragments of quartz, felspar and rock pieces together with mica, fragments of pumice and brown glass in a fine matrix of quartz, mica, felspar and glass. S. of the Basin limestone along the Basin Road there are outcrops of massive poorly exposured, unstratified tuff beds interbedded with rhyodacite flows. These are dark purplish rocks with some quartz up to 4 mm in diameter; felspar is fairly common up to 2 mm. Rock fragments are present usually about 5 mm in diameter and green chloritic material forms veinlets throughout the mass. Agglomeratic phases were noted in places.

Sediments

Narrow and restricted belts of sediments intercalated within the volcanics occur in a number of isolated areas. About ½ mile SW. of the junction of the Roger and Yalmy Rivers poorly exposed sediments have been revealed along a jeep track, but include yellow-brown and chocolate-brown micaceous siltstones interbedded with grey-green, and grey and orange, tuff beds. Blue-green chloritic material is common in the tuffs as streaks, and occasional quartz grains can be seen in the hand specimen. The sediments overlie a weathered outcrop of andesitic rhyodacite, and are in turn overlain by a hard purplish rhyodacite, medium grained and containing abundant quartz phenocrysts and felspar laths. A similar sequence of sediments can be seen on the track into 'Dargan's' on the east side of the Snowy R. immediately N. of the small limestone enclave, and again this outcrop is bounded on all sides by volcanics but its position in the section is not clear. The very poor exposures in this area make an estimate of the thickness difficult but there may be about 100 ft of section present. Dips within the sediments appear to be in the order of 80°. These beds may be equivalent to the Fairy Beds of Talent (1958). Other sedimentary strata believed to be of Lower Devonian age outcrop on the Raymond R. These are caught against the Yalmy Ck fault but have not been the subject of any detailed investigation at this time.

Middle Devonian

Buchan Caves Limestone

There are five discrete areas of limestone, all equivalent to the Buchan Caves Limestone in the mapped area. The largest of these outcrops on Basin Ck where an estimated 350+ ft of fossiliferous meso-grained limestone and dolomitic limestone is exposed including about 50± ft of Spring Creek Member equivalent.

On the NE. side of the outcrop the limestone overlies agglomerates and lavas of Snowy River Volcanics. The Spring Creek Member extends up the dip slope formed by the volcanics as a thin cover from Blue Bullock Ck and northwards towards Running Ck. The beds include interbedded tuffs, agglomerate, dolomitic limestones and sandy tuffs. Some of the finer clastics are cherty with occasional siliceous lenses and are well indurated. A band of limestone a few feet thick containing abundant *Aulopora* cf. *conglomerata* and *Syringopora flaccida*, outcrops in Blue Bullock Ck. A similar assemblage has been noted to occur within the Spring Creek Member in the Buchan Caves Reserve by Talent (1958). On the NW. side of the limestone similar beds outcrop in the northern arm of Spooners Ck. The sequence includes tuffs, mudstones, minor rhyodacite flows and a distinctive red and white fossiliferous band of jasper with manganiferous partings. Within the band the fossils are replaced by both jasper and chalcedony, the dominant tendency being infilling by chalcedony followed by replacement of matrix by jasper. These beds exhibit contradictory dips and are probably faulted. Farther W. the section becomes more volcanic until it is terminated by a fault breccia composed of quartzite fragments which borders the granodiorite. Within limestone between the Basin and Blue Bullock Creeks the following were collected and subsequently identified by Dr J. A. Talent:

Spinella buchanensis Talent
Chalcidophyllum recessum (Hill)
Favosites bryani Jones
Disphyllum? sp.
Buchanathyris?

Small gastropods cf. *Anematina*
Small brachiopod indet.
Algal pisoliths.

The above fauna is characteristic of the middle portion of Buchan Caves Limestone. Other limestone and dolomitic limestone bodies include those at Jackson's Crossing, Moore's Ford, the South Murrindal Mine area and a small patch on the lower Yalmy R. All of these bodies are Buchan Caves Limestone equivalents and owe their preservation to faulting.

Tertiary

Basalt

Basaltic dykes intrude Devonian sediments at Murrindal and other localities towards Buchan and have been considered as Tertiary by Teichert and Talent (1958). A dyke of probable similar age intrudes granodiorite in a road cut on the Basin Ridge Road just N. of Mt McLeod. A small area of basalt occurs on the S. bank of the Yalmy R., N. of Mt Tabby.

Sands and Gravels

Three areas of sands and gravels have been mapped S. of the Basin road. The deposits consist of yellowish to light greyish, poorly consolidated, poorly bedded clayish sands and gravels. The deposit south of the road junction of the Basin and Basin Ridge Roads is finer than the others and consists of yellow-orange sand with some iron banding and lies about 750 ft above sea level. At the head of Honeymoon Gully the gravel deposit at the top of the hill includes small boulders and large lumps of fossil wood. The pebbles consist of quartz, quartzite and some sandstone, usually well rounded and averaging about 2-3 inches diameter. The base of this deposit is about 680 ft above sea level. A small area of gravel occurs near the Dargan farm above Moore's Crossing, the base of which lies at approximately 830 ft above sea level.

The Buchan Caves Limestone—Snowy River Volcanics Contact

The nature of the contact between the Snowy River Volcanics and the Buchan Caves Limestone was previously considered by Teichert and Talent (1958) as being essentially conformable. However later mapping by Fletcher (1963) on the western side of the Buchan Basin seemed to indicate that a disconformity existed. Later work convinced Talent (pers. comm.) that a considerable time gap separated the cessation of volcanism from the initiation of true carbonate sedimentation. Where the contact can be seen along the Murrindal R. and on the eastern edge of the limestone on the Basin Ck, the dips of the volcanics and the limestone appear similar but the underlying volcanics are definitely not contemporaneous along the contact. At Mt Waterson, near Bindi, Buchan Group sediments can be seen resting upon the planated surface of fault blocks consisting of Snowy River Volcanics and Cowombat Group (Talent 1965). This type of relationship appears to exist in the Buchan area and is illustrated by considering the narrow belt of complexly faulted Ordovician sediments, pre-Devonian granodiorite, and Snowy River Volcanics which extends from Nowa Nowa through Mt McLeod towards Butchers Ck. This belt is controlled by faults with throws of considerable magnitude. However in the area immediately W. of the lower Buchan R. the belt is interrupted by a cover of Buchan Group sediments which exhibit far less deformation than would have been expected had they taken part in the main block faulting. The southern portion of the Buchan group in this area is controlled by tear faulting which, accompanied